WEALTH FROM SOLID WASTE

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One metric ton of wet salted hides/skins yields

Finished leather	300 kg
Tanned solidwaste	250 kg
Non tanned solid waste	350 kg
Liquid waste	100 kg

Non tanned solid wastes

Animal fleshing	56-60%
Skin trimming	5-7%
Hair	2-5%

Tanned solid wastes

Chrome shaving & chrome splits	95-98%
Buffing dust	2-5%

Mode of disposal

Incineration

Dumping onto open soil

Composition of Raw skins/hides

S.No.	Parameter	Value , in %
1.	Water	65
2,	Proteins	33
3.	Mineral matter	0.5
4.	Fatty substances	2-6
5.	Carbon	45-55
6.	Hydrogen	6-8
7.	Oxygen	19-25
8.	Nitrogen	16-19
9.	Sulphur	0.5-2.5

150 g of elemental carbon is turned out as solid waste .The carbon content may be converted into carbon dioxide during incineration or converted into methane gas on dumping .

WEALTH FROM BOVINE /OVINE HAIR

Animal hair is composed of over 90% protein

The main component being keratin , a fibrous and insoluble protein, which are extremely resistant to degradation by proteolytic enzymes due to cysteine disulphide

Keratinolytic micro-organisms have been used for the production of keratinases.

keratinases can degrade keratin without damaging the other structural proteins like collagen, make them an alternate agent to sulphide for use in leather industry

Keratin hydrolysates are widely used in cosmetics formulations and wide application in leather industry.

WEALTH FROM ANIMAL FLESHING

The ANFL has been considered as the substrate (carbon and energy) for the production of protease and lipase, as valuable products

Proteases find application in detergents, leather industry, food industry, pharmaceutical industry , laundry industry and bioremediation processes and wound healing processes

Proteases have been used in the hide-dehairing process.

Limed Fleshing

Parameter	Values
Total Organic Carbon mg/g	340 ± 21.2
Total Kjeldhal Nitrogen mg/g	130 ± 14.5
Moisture content (%)	29.5 ± 5.5
Ash content (%)	21.5 ± 2.9
Total protein (%)	67.8
Fat (%)	4.3
Carbohydrate (%)	0.175
Collagen (%)	3.5
N (%)	14.6 ± 0.3
C (%)	39.14 ± 0.5
S (%)	0.456 ± 0.1

ANIMAL FLESHING FOR BIOGAS RECOVERY
[Patented technology of Environology Division , CLRI]
Anaerobic biomethane formation from animal fleshing is a complex process, in which organic compounds are mineralised to biogas.

Finally, methanogenic bacteria which utilize methanol, acetate or hydrogen and carbon dioxide, produce methane . The methane recovery from anaerobic digestion of animal fleshing is 0.15 m^3/ kg of AnFl.

BIODIESEL, BIO ETHANOL, BIO HYDROGEN, BIOMETHANE FROM TANNERY SOLID WASTE:
There is a claim that Animal fleshing on fermentation produces long chain fatty acids and short chain fatty acids.
The long chain fatty acids may be transesterified to produce bio diesel.

After the separation of bio diesel the residual carbon is fermented further to get bio ethanol.
The fermented liquor after the extraction of biodiesel and bio ethanol may be further digested to recover bio hydrogen and bio methane.

ANIMAL FLESHING AS RAW MATERIAL FOR THE PRODUCTION OF BIO-ORGANIC MANURE
[Patented technology of Environmental Technology Division , CLRI]

❖In conventional bacterial composting small proportions of the total carbon and nitrogen were utilized by microbes during bacterial composting and the complex molecules were left unutilized.

❖There are emission of the greenhouse gases (CO_2, CH_4 and N_2O) during bacterial composting of solid wastes .

❖The residence time of 70-90 days was required for the composting of tannery waste into mature manure..

❖Vermicomposting is a viable, simple, and an economical process by which organic solid wastes are converted into organic manure .

EARTHWORM USED FOR MINERALISATION OF SOLIDWASTE

VERMICOMPOST OF ANIMALFLESHING

Type of composting	TKN (%)		TOC (%)		C/N ratio	
	Initial	Final (after 25 days)	Initial	Final (after 25 days)	Initial	Final (after 25 days)
Bacterial	0.79±0.047	1.41±0.098	45.6±2.28	24.5 ±1.47	57.7	17.37
Vermin	0.9±0.027	2.0±0.06	48.1±1.44	20.6 ±1.44	53.4	10.3

The process is faster than composting resulting earthworm castings (worm manure) are richer in microbial activity and plant growth regulators.

There would be an ample opportunity to reduce conventional energy use and lowering of greenhouse gas (GHG) emissions in vermin compost production .

ANIMAL FLESHING AS FISH MEAL
[Process of Environmental Technology Division, CLRI]

Protein is a critical component in complete fish feeds and generally the most expensive component accounting for more than 50% total feed cost in aquaculture .

Protein intake by fish is important to provide the amino acids required for synthesis of new tissues or replacing wornout proteins (maintenance) .

Protein is the major organic material in fish tissue making up 65-75% of total weight on a dry matter basis

The proportion of global fishmeal used for aquaculture has increased to a greater extent.

WEALTH FROM CHROME TANNED SOLID WASTE

TANNED LEATHER FOR THE PRODUCTION OF FUEL GAS

[Process of Environ. Tech. Division, CLRI]

Buffing dust may be regarded as the heavy metal ions embedded collagen matrix.

The disposal of buffing dust in an environmentally sound manner is an important task.

Pyrolysis in a fixed bed reactor at temperatures 450 - 600°C could produce Fuel gas, fuel oil, ammonium carbonate and carbonaceous residue .

Fuel gas (150 g indane gas equiv./kg of buffing dust)

The fuel oils , calorific value 7200 kcal/L

The carbonaceous residue (chars) were 37.5%-48.5%. calorific value 4300 - 6000 kcal/kg .

GENERATION OF FUEL GAS FROM PYROLISS OF Chromium LADEN SOLID WASTE

Parameters	value
Moisture content	11.15±2 %
Ash content	45.4±3.8 %
Bulk density	0.16±0.02 g cm^{-3}
Fat	4.69±0.26 %
Cr (III)	10.68±1.98 g/kg
Cr (IV)	BDL
Gross calorific value	4096±97 kcal /kg
Carbon	37.23±3 %
Hydrogen	6.19±0.7 %
Nitrogen	6.43±0.72 %
Sulfur	1.422±0.24 %
Oxygen	24.285±3.1 %

WEALTH FROM SALINE SOLID WASTE

Separation of edible grade salt from evaporated residue of R.O reject [Patented technology of Environmental Technology Division , CLRI]

Membrane separation recovers water by 70% and reject stream by 30%.

The reject stream is evaporated to get a solid residue which lacks the reusable option as it contains high concentration of impurities .

The disposal onto secured land fill ends with leachate containing the constituent ions and the treatability of leachate becomes more difficult .

SRIOM (Salt Recovery from Inorganic and Organic Mixture) process recovers the edible grade sodium chloride from the evaporated residue .

Recovered Salt

CONCLUSION

Leather industry generates solid wastes in a considerable quantity (700 kg/ ton of raw material) besides generation of wastewater.

The solid wastes constitute carbon , hydrogen , nitrogen and sulphur.

The intensive research carried out on the solid waste generated by leather industry end up with the production of value added products.

Hence, management of solid wastes either in isolation or in clusters may yield a substantial return to the tanners besides the final product.